

Documentation of Air Traffic Controller Color Vision Testing Compliance with the Uniform Guidelines on Employee Selection Procedures

Statement of Work

1. Purpose

The purpose of this study is to document the validity of the Air Traffic Controller Color Vision (ATCOV) test under the federal *Uniform Guidelines on Employee Selection Procedures* ("*Uniform Guidelines*"; 29 CFR § 1607). Briefly, the task requires a review and integration of available job/task analyses, studies and other data for the Air Traffic Control Specialist (ATCS; FG-2152) occupation to (a) identify critical or important duties, (b) describe how color is used in displays and other equipment in performing those critical or important duties, and (c) link those color uses to the Air Traffic Controller Color Vision (ATCOV) test.

2. Background

Air traffic controllers are responsible for the safe, efficient and orderly flow of traffic in the U.S. National Airspace System. Controllers in the cab of an air traffic control tower (ATCT) at airports are responsible for separating aircraft on the airport surface including taxiways and runways. Their primary tool is direct visual surveillance of the airport area. Controllers in the Terminal Radar Approach Control (TRACON) use radar displays to track aircraft positions in the airspace surrounding an airport. Controllers in Air Route Traffic Control Centers (ARTCCs, or "en route centers") use radar to track and monitor aircraft positions and altitudes in flights between airports.

Color is used in a variety of ways to communicate information to controllers. For example, different colored lights are used to distinguish taxiways from runways at night. Aircraft paint schemes (known as "livery"), particularly tail signs, are used by cab controllers to identify aircraft. In the TRACON, newer radar and other displays use color to represent weather, alerts, time, sequence, and other aircraft and airspace information. New displays for en route controllers use color as well to represent weather, alerts, aircraft separation status, and other information. Color is used to draw attention to critical or urgent targets, to identify categories of information, and to segment complex visual scenes.

Given the widespread use of color, the medical standards for the ATCS occupation require controllers to have normal color vision. Job applicant color vision is assessed in a post-offer pre-employment medical examination. Clinical instruments such as the Dvorine Psuedoiso chromatic Plates (Dvorine PIP) are used in that medical examination. Applicants who are identified as having a color vision deficiency in the medical examination are given a functional performance or practical test to determine if he or she can perform critical and/or important job duties. In the past, two practical tests were used: Aviation Signal Light; and Flight Strip Marking (Mertens, 1990). However, the proliferation of color displays in all three working environments (ATCT, TRACON, & ARTCC), coupled with the use of a broader palette of colors, requires using a new practical test.

Research to support the development of a new job-related practical test of color vision began in 2006 with assessments of color use in air traffic control (ATC) displays (see Xing & Schroeder, 2006a, b, c; Xing, 2006a, b; Xing, 2007a, b). Based on these analyses, computer-based tests of applicant color vision were developed. The Air Traffic Controller Color Vision (ATCOV; Xing, 2008a, b; Xing, Broach, Ling, Manning & Chidester, 2009) test is intended to be used as the practical or functional performance test for ATCS job candidates who fail the Dvorine PIP in the pre-employment medical examination. ATCOV is designed to assess whether candidates identified as having a color vision deficiency can use colors found in the ATCS workplace to detect targets, identify information, and read colored text (Xing, 2009a).

However, the perceptual and cognitive processes (target detection, information identification, and color text reading) represented by ATCOV need to be better and explicitly linked to the critical or important ATCS job duties in a manner that conforms to the reporting requirements of the *Uniform Guidelines*.

3. Statement of Work

Scope of work. The scope of work for this contract is to review and integrate available information to document the linkage between the cognitive processes represented by ATCOV and critical or important duties and tasks performed by air traffic controllers in a report complying with the reporting requirements of the Uniform Guidelines.

Level of analysis. Available job/task analyses (JTAs) for controllers are based on hierarchical task analysis models. The primary documents describe the work of controllers at three or four levels of analysis. The highest descriptive level is an “activity.” As defined by Ammerman, Becker, Jones, Tobey and Phillips (1987), an activity corresponds to a major job duty. An activity is decomposed in the ATCS JTAs into sub-activities. Ammerman, et al. define a sub-activity as the set of operations that are performed in response to a single event. Sub-activities are decomposed into tasks, where a task is the smallest discrete unit of work performance directed toward achieving an identifiable goal whose attainment signifies completion of the task. The level of analysis for this contract will be at the sub-activity level.

Task 1. Conduct project start (“kick-off”) meeting with designated FAA staff.

Task 2: Identify the ATC displays and use of colors for all sub-activities listed in the American Institutes for Research (AIR; 2007) job analyses for ATCT, TRACON, and ARTCC positions. The contractor shall analyze documentation provided by the FAA and identify the ATC display used in the performance of each sub-activity. Systems using color in these environments include Voice Switching and Control System (VSCS), User Request Evaluation Tool (URET), Enroute Information Display System (ERIDS), Display System Replacement (DSR), and Enhanced Status Information System (ESIS). Based on the contractor’s review of documentation and systems, the contractor shall also describe how color is used by controllers in each sub-activity with specific reference to the underlying processes of target identification, information identification, and reading of colored text. [The FAA may, at its discretion, provide the contractor with the opportunity to observe controller performance in ATCT cab, TRACON, and ARTCC simulators at the FAA Academy or at field facilities.] The contractor shall document the

results of this task in an interim report that explicitly describes the information sources used, methods, and results of work performed under this task.

Task 3: Map ATCOV tests to each sub-activity performed by controllers using ATC displays. Finally, the contractor shall map ATCOV tests to each sub-activity performed by controllers using ATC displays. The contractor shall report the methods and results of this task in a technical report. This report may be delivered to the FAA as an expansion of the interim report delivered under Task 2.

Task 4: Write a formal technical report on ATCOV validity that conforms to the Uniform Guidelines reporting requirements. The contractor shall write a formal report describing the linkages between ATCOV tests and ATCS sub-activities that conforms with the reporting requirements of the Uniform Guidelines. The report shall be comprehensive, and include all information and data developed in Tasks 2 and 3.

4. Contract Deliverables

Task 1: Kick-off meeting notes.

Task 2: Interim report describing the information sources, methods, and results of identification of ATC displays used in performance of ATCS sub-activities and how color is used in those displays with particular reference to the underlying processes of target identification, information identification, and reading of color text.

Task 3: Interim report describing the information sources, methods and results of mapping ATCOV tests to ATCS sub-activities.

Task 4: Draft final report integrating the interim reports into a single, unified report that conforms to the reporting requirements of the Uniform Guidelines.

Task 5: Final report incorporating FAA comments.

5. Schedule

Task 1 through 5 are business days (excluding federal holidays) subsequent to contract award.

Task	Deliverable	Date
1	Kick-off meeting notes	+18
2	Equipment & color in important sub-activities interim report	+69
3	ATCOV to important sub-activities interim report	+90
4	Draft final report	+112
5	Final report	+142

6. Acceptance

Deliverables will be evaluated for acceptance with respect to

- 1) Adherence to the statement of work;
- 2) Timeliness;
- 3) Perceived value to on-going project progress; and
- 4) Conformance to Uniform Guidelines reporting requirements.

7. Government Participation

The FAA Civil Aerospace Medical Institute Aerospace Human Factors Research Division will provide the contractor with ATCS job/task analysis and other relevant FAA reports and documents in electronic form on a CD, and at its option, in print form. The documents to be provided by the FAA are listed in Section 12 (References).

The FAA Civil Aerospace Medical Institute Aerospace Human Factors Research Division (AAM-500) will participate by fulfilling the responsibilities associated with the role of the contracting officer's technical representative. These responsibilities include the evaluation of the deliverable.

8. Government Furnished Equipment

No equipment will be provided or furnished to the contractor by the government.

9. Confidentiality of Data and Research Products

Any data provided by the Civil Aerospace Medical Institute for this procurement are confidential and may not be disclosed, distributed, duplicated, or otherwise disseminated by the contractor without explicit written permission of the FAA. No presentation or publication derived from this work may be given or submitted without the explicit written permission of the FAA.

10. Required Qualifications and Experience

The contractor must have advanced experience and understanding in the field of color vision or color vision testing, advanced understanding of methods of task analysis or the application of task analysis to Air Traffic Control positions, and understanding of or access to expertise in application of the *Uniform Guidelines* to selection tests.

11. Estimated Efforts

CAMI anticipates a contractor effort of 4 months by a senior research psychologist or medical specialist (Ph.D., M.D., or equivalent experience) and 4 months by a junior research psychologist or medical specialist (B.A., B.S., M.A., or M.S., or equivalent experience). We estimate four trips to CAMI and two trips to the FAA Academy and/or Air Traffic facilities by the senior contract employee.

12. References

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